What is claimed is:

1. A method of passively determining agile-frequency-emitter location, comprising the steps of:

measuring during a single receiver dwell:

phase at a minimum of three different carrier frequencies on a single interferometer baseline; wherein:

each frequency measurement occurs with a phase measurement; and

each corresponding interferometer baseline position, the position simultaneous to the phase and frequency measurements;

processing the measurements measured by the measuring step by:

multiplying each baseline by the corresponding frequency;

forming a linearly independent set of differences of these baseline-frequency products; and

forming the corresponding set of phase differences;

determining the measuring step has obtained sufficient phase, frequency and baseline measurements, comprising:

based on the linearly independent set of differences of baseline-frequency products produced by the processing step, predicting the accuracy of a direction of arrival unit vector or COS(*AOA*) to be that will be computed from the corresponding set of phase differences;

repeating the measuring step and processing step until the predicted accuracy meets or exceeds a desired specified accuracy;

computing an array A of gains based on the set of baseline-frequency product differences, where there is a gain for each difference, and the sum of the differences weighed by each corresponding gain is a null vector;

computing the phase difference ambiguity integers for all the phase difference measurements by:

processing the phase difference measurements corresponding to the set of baseline-frequency products by:

multiplying each phase difference with the corresponding gain, where the gain was previously determined; and

summing these products to form a fundamental test metric;

forming all possible sequences of permissible ambiguity integers, such that each sequence is an array having the same dimensions as the set of phase differences;

testing each integer set thus formed by:

weighting each integer in the set with the corresponding gain determined in the computing an array step;

summing these weighted values; and

choosing the sum closest to the fundamental test metric; and

resolving the set of phase differences with the set of integers whose sum has the value closest to that of the fundamental test metric by adding the integer array to the phase array;

estimating the emitter DOA unit vector $\vec{u}$ or COS(AOA) by:

computing a second array Λ of gains from the set of baseline-frequency product differences, where the matrix product of the gains and differences is the identity matrix;

determining the rank of the set of baseline-frequency product differences;

estimating $\vec{u}$ if the rank is greater than 1, and COS(AOA) otherwise, by forming the matrix product of Λ with the phase differences corresponding to the baseline-frequency differences;

predicting the LBI phase differences, the differences occurring between receiver dwells, by:

if the rank of the set of baseline-frequency product differences is greater than 1, performing the steps of:

projecting the DOA unit vector found in each dwell on a single baseline measured in that dwell; and

scaling the projected value by the measured frequency corresponding to the baseline measurement;

else if the rank of the set of baseline-frequency product differences is 1, performing the steps of:

forming the product of the COS(AOA) and baseline length;

scaling the product by the measured frequency corresponding to the measured phase being resolved;

resolving the corresponding ambiguous measured phase difference by:

differencing the ambiguous phase difference with the predicted phase difference and estimating the resulting integer value;

adding the integer value to the ambiguous phase; and

associating the resolved phase change with spatial angle change and estimating emitter range from the angle change.

2. The method of claim 1 wherein the linearly independent set of differences of the baseline-frequency products is formed by:

determining the linearly independent set of frequency differences having the maximum frequency change; and

forming the differences of the corresponding baseline-frequency products.

3. The method of claim 1 wherein, when the rank of the set of baseline-frequency product differences is greater than 1, COS(AOA) is computed by projecting the DOA unit vector onto the interferometer baseline unit vector.

4. The method of claim 1 wherein, in the logic step, in the predicted accuracy test, the desired accuracy is determined by the accuracy required to predict the ambiguity integer in the LBI resolving step, so that the probability the estimated integer is the correct integer exceeds a preset performance threshold.

5. The method of claim 1 where, in the logic step, in the predicted accuracy test, the desired accuracy is determined by the accuracy required to estimate emitter location from the DOA unit vector $\vec{u}$, where this estimation accuracy exceeds a preset performance value.

6. The method of claim 1, wherein the estimation accuracy is predicted from the linearly independent set of differences of baseline-frequency products by utilizing standard maximum likelihood estimation (MLE) processing, with the set of baseline differences identified with the measurement matrix of a linear estimator, and where the predicted accuracy is the Cramer-Rao bound for the corresponding MLE.

7. The method of claim 3, wherein the estimation accuracy is predicted from the linearly independent set of differences of baseline-frequency products by utilizing standard maximum likelihood estimation (MLE) processing, with the set of baseline differences identified with the measurement matrix of a linear estimator, and where the predicted accuracy is the Cramer-Rao bound for the corresponding MLE.

8. The method of claim 4, wherein the estimation accuracy is predicted from the linearly independent set of differences of baseline-frequency products by utilizing standard maximum likelihood estimation (MLE) processing, with the set of baseline differences identified with the measurement matrix of a linear estimator, and where the predicted accuracy is the Cramer-Rao bound for the corresponding MLE.

9. The method of claim 1, wherein the estimated DOA unit vector $\vec{u}$ in a single receiver dwell is used to locate the emitter by extending the line $\vec{u}$ lies on to intersect the earth's surface, the point of intersection being the estimated emitter position.

10. The method of claim 1, wherein the DOA unit vector is utilized to determine emitter azimuth and elevation, and these angles are then used to locate the emitter.

11. The method of claim 1, wherein the associating step performing emitter location also utilizes the DOA unit vectors found in each receiver dwell to locate the emitter in angle as well as range.

12. The method of claim 1, wherein the DOA unit vector is used to establish the initial region for the assumed emitter location grid used in the AOA/LBI hypothesis test for locating the emitter.

13. The method of claim 9, wherein the DOA unit vector is used to establish the initial region for the assumed emitter location grid used in the AOA/LBI hypothesis test for locating the emitter.

14 The method of claim 1, wherein the estimated COS(*AOA*) is utilized to cluster phase measurements from a batch-agile emitter, comprising:

using a conventional short baseline interferometer (SBI) to obtain COS(AOA) for phase measurements at the same frequency;

comparing the SBI COS(AOA) with the estimated COS(AOA); and

associating the pulses with a single emitter if the comparison is within the phase measurement and COS(*AOA*) estimation error.

15. The method of claim 3, wherein the estimated COS(*AOA*) is utilized to cluster phase measurements from a batch-agile emitter, comprising:

using a conventional short baseline interferometer (SBI) to obtain COS(*AOA*) for phase measurements at the same frequency;

comparing the SBI COS(*AOA*) with the estimated COS(*AOA*); and

associating the pulses with a single emitter if the comparison is within the phase measurement and COS(*AOA*) estimation error.

16. The method of claim 1, wherein each frequency measurement occurs simultaneous with a phase measurement.

17. The method of claim 1, wherein a frequency measurement simultaneous with a phase measurement is determinable.

18. The method of claim 17, wherein the determinable frequency measurement is determinable by extrapolation and interpolation.

19. An apparatus for passively determining agile-frequency-emitter location, comprising:

measuring means for measuring, during a single receiver dwell, phase at a minimum of three different carrier frequencies on a single interferometer baseline, wherein the measuring means is adapted to measure frequency, phase, and a corresponding interferometer baseline position;

a processor for processing the measurements measured by the measuring means by (1) multiplying each baseline by the corresponding frequency, (2) forming a linearly independent set of differences of the baseline-frequency products, and (3) forming a corresponding set of phase differences;

determining means for determining the measuring step has obtained sufficient phase, frequency, and baseline measurements by being adapted to (1) based on the linearly independent set of differences of baseline-frequency products produced by the processor, predict the accuracy of a direction of arrival unit vector or COS(AOA) to be computed from the corresponding set of phase differences, (2) cause repeated measuring by the measuring means and repeated processing by the processor until a predicted accuracy meets or exceeds a desired specified accuracy;

computing means for computing (1) an array A of gains based on the set of baseline-frequency product differences, where there is a gain for each difference, and the sum of the differences weighted by the corresponding gain is a null vector and (2) the phase difference ambiguity integers for all the phase difference measurements by (a) processing the phase difference measurements corresponding to the set of baseline-frequency products by (i) multiplying each phase difference with the corresponding gain, where the gain was previously determined and (ii) summing the products to form a

fundamental test metric; (b) forming all possible sequences of permissible ambiguity integers, such that each sequence is an array having the same dimensions as the set of phase differences; (c) testing each integer set thus formed by (i) weighting each integer in the set with the corresponding gain, (ii) summing the weighted values, and (iii) choosing the sum closest to the fundamental test metric; and (d) resolving the set of phase differences with the set of integers whose sum has the value closest to that of the fundamental test metric by adding the integer array to the phase array;

estimating means for estimating the emitter DOA unit vector or COS(AOA) by (1) computing a second array Λ of gains from the set of baseline-frequency product differences, where the matrix product of the gains and differences is the identity matrix, (2) determining the rank of the set of baseline-frequency product differences, (3) estimating $\vec{u}$ if the rank is greater than 1, and COS(AOA) otherwise, by forming the matrix product of Λ with the phase differences corresponding to the baseline-frequency differences;

predicting means for predicting the LBI phase differences by (1) if the rank of the set of baseline-frequency product differences is greater than 1, the predicting means being adapted to (a) project the DOA unit vector found in each dwell on a single baseline measured in that dwell, (b) scale the projected value by the measured frequency corresponding to the baseline measurement, and (2) if the rank of the set of baseline-frequency product differences is 1, the predicting means being adapted to (a) form the product of the COS(AOA) and baseline length, (b) scale the product by the measured frequency corresponding to the measured phase being resolved, (c) resolve the corresponding ambiguous measured phase difference by (i) difference the ambiguous phase difference with the predicted phase difference and estimate the resulting integer value, (ii) add the integer value to the ambiguous phase, and (iii) associate the resolved phase change with spatial angle change and estimate emitter range from the angle change.

20. The apparatus of claim 19 wherein the linearly independent set of differences of the baseline-frequency products is formed by:

determining the linearly independent set of frequency differences having the maximum frequency change; and

forming the differences of the corresponding baseline-frequency products.

21. The apparatus of claim 19 wherein when the rank of the set of baseline-frequency product differences is greater than 1, COS(AOA) is computed by projecting the DOA unit vector onto the interferometer baseline unit vector.

22. The apparatus of claim 19 wherein the determining means determines the desired accuracy by the accuracy required to predict the ambiguity integer in the LBI resolving step, such that the probability the estimated integer is the correct integer exceeds a preset performance threshold.

23. The apparatus of claim 19 wherein the determining means determines the desired accuracy by the accuracy required to estimate emitter location from the DOA unit vector, wherein the estimation accuracy exceeds a preset performance value.

24. The apparatus of claim 19, wherein the estimation accuracy is predicted from the linearly independent set of differences of baseline-frequency products by utilizing standard maximum likelihood estimation (MLE) processing, with the set of baseline differences identified with the measurement matrix of a linear estimator, and where the predicted accuracy is the Cramer-Rao bound for the corresponding MLE.

25. The apparatus of claim 21, wherein the estimation accuracy is predicted from the linearly independent set of differences of baseline-frequency products by utilizing standard maximum likelihood estimation (MLE) processing, with the set of baseline differences identified with the measurement matrix of a linear estimator, and where the predicted accuracy is the Cramer-Rao bound for the corresponding MLE.

26. The apparatus of claim 22, wherein the estimation accuracy is predicted from the linearly independent set of differences of baseline-frequency products by utilizing standard maximum likelihood estimation (MLE) processing, with the set of baseline differences identified with the measurement matrix of a linear estimator, and where the predicted accuracy is the Cramer-Rao bound for the corresponding MLE.

27. The apparatus of claim 19, wherein the estimated DOA unit vector in a single receiver dwell is used to locate the emitter by extending the line $\vec{u}$ lies on to intersect the earth's surface, the point of intersection being the estimated emitter position.

28. The apparatus of claim 19, wherein the DOA unit vector is utilized to determine emitter azimuth and elevation, and these angles are then used to locate the emitter.

29. The apparatus of claim 19, wherein the association performed to determine emitter location also utilizes the DOA unit vectors found in each receiver dwell to locate the emitter in angle as well as range.

30. The apparatus of claim 19, wherein the DOA unit vector is used to establish the initial region for the assumed emitter location grid used in the AOA/LBI hypothesis test for locating the emitter.

31. The apparatus of claim 27, wherein the DOA unit vector is used to establish the initial region for the assumed emitter location grid used in the AOA/LBI hypothesis test for locating the emitter.

32. The apparatus of claim 19, wherein the estimated COS(AOA) is utilized to cluster phase measurements from a batch-agile emitter, comprising:

using a conventional short baseline interferometer (SBI) to obtain COS(AOA) for phase measurements at the same frequency;

comparing the SBI COS(AOA) with the estimated COS(AOA); and

associating the pulses with a single emitter if the comparison is within the phase measurement and COS(AOA) estimation error.

33. The apparatus of claim 21, wherein the estimated COS(AOA) is utilized to cluster phase measurements from a batch-agile emitter, comprising:

using a conventional short baseline interferometer (SBI) to obtain COS(AOA) for phase measurements at the same frequency;

comparing the SBI COS(AOA) with the estimated COS(AOA); and

associating the pulses with a single emitter if the comparison is within the phase measurement and COS(AOA) estimation error.

34. The apparatus of claim 19, wherein each frequency measurement occurs simultaneous with a phase measurement.

35. The apparatus of claim 19, wherein a frequency measurement simultaneous with a phase measurement is determinable.

36. The apparatus of claim 35, wherein the determinable frequency measurement is determinable by extrapolation and interpolation.

37. A computer-readable medium comprising:

a data structure for phase, frequency, and baseline position measurements;

at least one sequence of machine executable instructions in machine form, wherein execution of the instructions by a processor cause the processor to:

measure during a single receiver dwell:

phase at a minimum of three different carrier frequencies on a single interferometer baseline; wherein:

each frequency measurement occurs with a phase measurement; and

each corresponding interferometer baseline position, the position simultaneous to the phase and frequency measurements;

process the measurements measured by the measuring step by:

multiplying each baseline by the corresponding frequency;

forming a linearly independent set of differences of these baseline-frequency products; and

forming the corresponding set of phase differences;

determine the measuring step has obtained sufficient phase, frequency and baseline measurements, comprising:

based on the linearly independent set of differences of baseline-frequency products produced by the processing step, predicting the accuracy of a direction of arrival unit vector or COS(AOA) to be that will be computed from the corresponding set of phase differences;

repeating the measuring step and processing step until the predicted accuracy meets or exceeds a desired specified accuracy;

compute an array A of gains based on the set of baseline-frequency product differences, where there is a gain for each difference, and the sum of the differences weighed by each corresponding gain is a null vector;

compute the phase difference ambiguity integers for all the phase difference measurements by:

processing the phase difference measurements corresponding to the set of baseline-frequency products by:

multiplying each phase difference with the corresponding gain, where the gain was previously determined; and

summing these products to form a fundamental test metric;

forming all possible sequences of permissible ambiguity integers, such that each sequence is an array having the same dimensions as the set of phase differences;

testing each integer set thus formed by:

weighting each integer in the set with the corresponding gain;

summing these weighted values; and

choosing the sum closest to the fundamental test metric; and

resolving the set of phase differences with the set of integers whose sum has the value closest to that of the fundamental test metric by adding the integer array to the phase array;

estimate the emitter DOA unit vector $\vec{u}$ or COS(AOA) by:

computing a second array Λ of gains from the set of baseline-frequency product differences, where the matrix product of the gains and differences is the identity matrix;

determining the rank of the set of baseline-frequency product differences;

estimating $\vec{u}$ if the rank is greater than 1, and COS(AOA) otherwise, by forming the matrix product of Λ with the phase differences corresponding to the baseline-frequency differences;

predict the LBI phase differences, the differences occurring between receiver dwells, by:

if the rank of the set of baseline-frequency product differences is greater than 1, performing the steps of:

projecting the DOA unit vector found in each dwell on a single baseline measured in that dwell; and

scaling the projected value by the measured frequency corresponding to the baseline measurement;

else if the rank of the set of baseline-frequency product differences is 1, performing the steps of:

forming the product of the COS(AOA) and baseline length;

scaling the product by the measured frequency corresponding to the measured phase being resolved;

resolving the corresponding ambiguous measured phase difference by:

differencing the ambiguous phase difference with the predicted phase difference and estimating the resulting integer value;

adding the integer value to the ambiguous phase; and

associating the resolved phase change with spatial angle change and estimating emitter range from the angle change.

38. The computer-readable medium of claim 37 further including a sequence of instructions which, when executed by the processor, cause the processor to form the linearly independent set of differences of the baseline-frequency products by:

determining the linearly independent set of frequency differences having the maximum frequency change; and

forming the differences of the corresponding baseline-frequency products.

39. The computer-readable medium of claim 37 further including a sequence of instructions which, when the rank of the set of baseline-frequency product differences is greater than 1, cause the processor to compute COS(AOA) by projecting the DOA unit vector onto the interferometer baseline unit vector.

40. The computer-readable medium of claim 37 further including a sequence of instructions which, when executed by the processor, cause the processor to determine the desired accuracy by the accuracy required to predict the ambiguity integer in the LBI resolving step, such that the probability the estimated integer is the correct integer exceeds a preset performance threshold.

41. The computer-readable medium of claim 37 further including a sequence of instructions which, when executed by the processor, cause the processor to determine the desired accuracy by the accuracy required to estimate emitter location from the DOA unit vector, wherein the estimation accuracy exceeds a preset performance value.

42. The computer-readable medium of claim 37 further including a sequence of instructions which, when executed by the processor, cause the processor to predict estimation accuracy from the linearly independent set of differences of baseline-frequency products by utilizing standard maximum likelihood estimation (MLE) processing, with the set of baseline differences identified with the measurement matrix of a linear estimator, and where the predicted accuracy is the Cramer-Rao bound for the corresponding MLE.

43. The computer-readable medium of claim 39, wherein the estimation accuracy is predicted from the linearly independent set of differences of baseline-frequency products by utilizing standard maximum likelihood estimation (MLE) processing, with the set of baseline differences identified with the measurement matrix of a linear estimator, and where the predicted accuracy is the Cramer-Rao bound for the corresponding MLE.

44. The computer-readable medium of claim 40, wherein the estimation accuracy is predicted from the linearly independent set of differences of baseline-frequency products by utilizing standard maximum likelihood estimation (MLE) processing, with the set of baseline differences identified with the measurement matrix of a linear estimator, and where the predicted accuracy is the Cramer-Rao bound for the corresponding MLE.

45. The computer-readable medium of claim 37, wherein the estimated DOA unit vector in a single receiver dwell is used to locate the emitter by extending the line $\vec{u}$ lies on to intersect the earth's surface, the point of intersection being the estimated emitter position.

46. The computer-readable medium of claim 37, wherein the DOA unit vector is utilized to determine emitter azimuth and elevation, and these angles are then used to locate the emitter.

47. The computer-readable medium of claim 37, wherein the association performed to determine emitter location also utilizes the DOA unit vectors found in each receiver dwell to locate the emitter in angle as well as range.

48. The computer-readable medium of claim 37, wherein the DOA unit vector is used to establish the initial region for the assumed emitter location grid used in the AOA/LBI hypothesis test for locating the emitter.

49. The computer-readable medium of claim 45, wherein the DOA unit vector is used to establish the initial region for the assumed emitter location grid used in the AOA/LBI hypothesis test for locating the emitter.

50. The computer-readable medium of claim 37, wherein the estimated COS(AOA) is utilized to cluster phase measurements from a batch-agile emitter, comprising:

using a conventional short baseline interferometer (SBI) to obtain COS(AOA) for phase measurements at the same frequency;

comparing the SBI COS(AOA) with the estimated COS(AOA); and

associating the pulses with a single emitter if the comparison is within the phase measurement and COS(AOA) estimation error.

51. The computer-readable medium of claim 39, wherein the estimated COS(AOA) is utilized to cluster phase measurements from a batch-agile emitter, comprising:

using a conventional short baseline interferometer (SBI) to obtain COS(AOA) for phase measurements at the same frequency;

comparing the SBI COS(AOA) with the estimated COS(AOA); and

associating the pulses with a single emitter if the comparison is within the phase measurement and COS(AOA) estimation error.

52. The computer-readable medium of claim 37, wherein each frequency measurement occurs simultaneous with a phase measurement.

53. The computer-readable medium of claim 37, wherein a frequency measurement simultaneous with a phase measurement is determinable.

54. The computer-readable medium of claim 53, wherein the determinable frequency measurement is determinable by extrapolation and interpolation.